

## Urinary Tract Infection in High-Risk Pregnancy: A Hospital-Based Study

Muhib Muhammed Kabir<sup>1\*</sup>, Mehnaz Kabir<sup>2</sup>, M M Faniqul Islam<sup>3</sup>, Ramisa Haque<sup>4</sup>

<sup>1</sup>MBBS, MRCP, Medical Officer, Department of Nephrology, Bangladesh Medical College & Hospital, Dhaka, Bangladesh

<sup>2</sup>MBBS, MPH, Assistant Professor (CC) Department of Community Medicine, Bangladesh Medical College & Hospital, Dhaka, Bangladesh

<sup>3</sup>MBBS, PGDip, MSc, MRes, Lecturer, MSc Healthcare Leadership, BPP University, Lecturer (part time), Regent College London, England

<sup>4</sup>BDS, MPH (Thesis part), Department of Epidemiology, North South University, Dhaka, Bangladesh

DOI: <https://doi.org/10.36347/sasjm.2024.v10i12.007>

| Received: 02.11.2024 | Accepted: 10.12.2024 | Published: 16.12.2024

\*Corresponding author: Muhib Muhammed Kabir

MBBS, MRCP, Medical Officer, Department of Nephrology, Bangladesh Medical College & Hospital, Dhaka, Bangladesh

### Abstract

### Original Research Article

**Background:** Unexplained recurrent pregnancy loss with symptoms of urinary tract infection (UTI) is alarming. However, with prompt diagnosis and proper treatment, a healthy, full-term pregnancy can be achieved and the complications can be prevented. **Objectives:** To assess the fetal and maternal outcomes after completion of treatment with antimicrobials in pregnant women with recurrent UTI. **Methods:** A sum of 140 pregnant women with UTI symptoms were enrolled in this prospective, observational study attending the Internal Medicine OPD in BSMMU, Dhaka, Bangladesh. These patients had history of recurrent abortions with no significant medical conditions, only having symptoms of urinary tract infection. Baseline urinalysis and culture & sensitivity were done; full course of nitrofurantoin and cranberry were prescribed to these patients and finally repeat routine urinary examination was done. The fetal & maternal outcomes were assessed at the end of delivery. **Results:** The findings revealed 80.0% participants belonged to age range 25-<35 years; 91.4% belonged to middle socio-economic background; 95.7% of them had 3 previous abortions and 83.6% of them had symptoms of UTI but were untreated which resulted in abortions. In addition, 97% attended regular antenatal care (ANC) visits during current pregnancy. Besides, 95.7% indulged in frequent tea consumption and 90.0% cases complained of increased frequency of micturition as their sole clinical manifestation. Furthermore, before treatment, 97.1% had pyuria and in 62.9% urine cultures, E. coli was the commonest organism. After treatment, 100% patients had pus cells in urine 0-5 in number. Lastly, 83.6% deliveries were conducted by Caesarean section and all deliveries were done at term; all were live births and birth weight was  $\geq 2.5$  kg. At discharge, 100.0% mothers and babies were healthy and stable. **Conclusion:** It can be concluded that, treatment with suitable antibiotics and proper ANC visits can prevent all the adversities and lead to delivery of healthy babies. Optimum monitoring and awareness is essential throughout any pregnancy to ensure good outcomes.

**Keywords:** Urinary tract infection; recurrent pregnancy loss; unexplained recurrent abortion; high-risk pregnancy; valuable pregnancy; maternal mortality; neonatal mortality; routine urine tests; cystitis; pyelonephritis.

Copyright © 2024 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC 4.0) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

## INTRODUCTION

Urinary tract infection (UTI) is one of the most common bacterial infections in pregnant women in most of developing countries like Bangladesh [1]. The prevalence of UTI in pregnancy depends on parity, race and socioeconomic status, individual hygiene and anemia. It is found that, prevalence of UTI in pregnant women in America is 2.5-8.7%, whereas the prevalence of UTI in pregnant women in developing countries is around 12-40% [2]. The differences can be explained by the socio-economic status, living standards, hygiene

levels, awareness about maintenance of optimum health during pregnancy and access to health care facilities [1,2]. In addition, this heightened susceptibility of UTI in pregnancy is primarily due to physiological changes during pregnancy, such as increased pressure from the gravid uterus on the ureter, resulting in urinary stasis, as well as alterations in urine composition, including elevated glucose and amino acid levels, which promote bacterial growth [3].

Pregnancy is a universal part of female biology and physiology. Nearly 500,000 women die globally

**Citation:** Muhib Muhammed Kabir, Mehnaz Kabir, M M Faniqul Islam, Ramisa Haque. Urinary Tract Infection in High-Risk Pregnancy: A Hospital-Based Study. SAS J Med, 2024 Dec 10(12): 1393-1401.

every year due to pregnancy-related causes. For each death, approximately 118 women suffer from life-threatening events or severe acute morbidity [4]. All pregnancies should hence be screened for the existence of risk factors. Elements to be taken into account include age, parity, social class, history of chronic disease (hypertension, diabetes mellitus, heart disease, thyroid disease and so on), history of previous pregnancy complications and multiple previous pregnancies [5].

Receiving ante natal care (ANC) a minimum of four times, which is usually recommended by the World Health Organization, will increase the chances of receiving effective and efficient maternal care for the duration of the antenatal visits [6]. The main objectives of the ANC are as follows: (i) maintenance of the health of the mother during pregnancy; (ii) identification of high-risk cases and appropriate management; (iii) prevention of development of complications; (iv) decrease of maternal and infant mortality and morbidity; (v) removal of the stress and worries of the mother regarding the delivery process; (vi) education of the mother about child-care/nutrition/sanitation/hygiene; (vii) advice about family planning; (viii) care of children under five years old accompanying pregnant mothers [4].

Our point of concern is a major high-risk factor which is recurrent pregnancy loss. Recurrent pregnancy loss (RPL) is defined as  $\geq 3$  consecutive losses of clinical pregnancy documented by ultrasound or histopathologic exam [7]. Furthermore, it has been speculated that, urinary tract infections, if left untreated during pregnancy periods, can progress to a major infection which may lead to preterm labor, premature delivery or even fetal loss [8].

Any infection requires proper treatment and evaluation. Studies suggest there is some evidence that untreated asymptomatic bacteriuria (ASB) (at least  $10^3$  colonies per mL) can progress to acute pyelonephritis, which is associated with higher maternal and neonatal morbidity [9]. Antimicrobials are empirical for the treatment of UTIs to reduce the associated risks. A relevant study [10] has shown that a major reduction of ASB was found in women with a high clinic attendance rate and who received nitrofurantoin and close surveillance. Furthermore, international guidelines suggested that, when referring to lines of treatment, as first line, nitrofurantoin, Fosfomycin and amoxicillin were proposed. Second-line treatments were pivmecillinam, cephalixin and amoxicillin (if sensitive) [11].

However, the use of antimicrobials in pregnancy requires careful consideration for multiple reasons. First, an association with birth defects were found in some studies. [12] However, it is important to note that the absolute risk of these birth defects is low: oral clefts, 0.99%; esophageal atresia, 0.22%; and anorectal atresia, 0.41%. Second, antibiotics may

alter the fetal gastrointestinal flora and may affect bone, cardiovascular and immune system development. Lastly the rising prevalence of antimicrobial resistance is a tremendous challenge to combat for the clinicians to treat UTIs during pregnancy [9].

This study tends to investigate the maternal and fetal outcomes of those women with history of recurrent pregnancy losses with symptoms of urinary tract infections currently treated with antimicrobials. It also highlights the effectiveness of regular ante-natal check ups as well as proper diagnosis and treatment of underlying conditions to ensure safe and healthy delivery of the fetus.

## METHOD

### Study design, settings and participants

This prospective, observational study was conducted in the Outpatient Department of Internal Medicine, Bangabandhu Sheikh Mujib University (BSMMU) during October 2023 to September 2024, a period of 12 months. The study was aimed to discover the importance of optimum antenatal visits and the outcome of proper treatment of urinary tract infections during pregnancy. We recruited a total of 140 patients which depended upon the availability of patients during this course of time who fulfilled our selection criteria. The vaginal swab was taken from the study sample and analyzed to exclude vaginal infection according to the hospital rules.

### Inclusion criteria:

- Pregnant women (any trimester) presenting with symptoms of UTI.
- Pregnant women with history of recurrent pregnancy loss who experienced symptoms of UTI but left it untreated.
- Those patients who performed extensive laboratory investigations but their loss of pregnancy was unexplained.
- Pregnant women with regular antenatal check-ups during current pregnancy.
- Age  $\geq 18$  years to 45 years.

### Exclusion criteria

- Pregnant women with pre-existing kidney diseases.
- Those who are diagnosed previously with antiphospholipid syndrome.
- Those with anatomic or functional congenital urinary abnormalities.
- Those who refused to do Urine R/E and Urine Culture & Sensitivity tests.
- Those who received any sort of treatment for UTI during current pregnancy.
- Those who were not willing to give written, informed consent.

These participants were selected by purposive method of sampling. Face-to-face interviews were conducted using a structured questionnaire. Previous and current medical records were assessed and taken into account.

### Laboratory investigations

For confirmation of diagnosis and proper treatment, urinalysis by urine R/M/E method (routine microscopic examination) and urine culture & sensitivity.

The urine R/M/E test, is a non-invasive test that analyzes urine samples to check for diseases, infections and organ malfunction. Urine may be collected at any time of the day but early morning sample and mid-stream urine (MSU) is preferred for the test. 10-20 ml of urine is required in a sterile container.

The test involves three parts:

- **Physical examination:** The urine is visually examined for color, odor and clarity.
- **Chemical examination:** The urine is tested for substances like glucose, protein, pH, specific gravity, blood, nitrites, ketone bodies, bilirubin and urobilinogen.
- **Microscopic examination:** The urine is examined under a microscope for cells, bacteria, casts, crystals and yeast [13].

The urine culture & sensitivity test is a diagnostic tool that identifies and treats UTIs:

- **Culture:** Determines if bacteria or other germs are present in a urine sample.
- **Sensitivity:** Determines which antibiotics are effective against the bacteria or other germs.

A urine culture & sensitivity test helps us to target the specific bacteria causing the infection; select the most effective antibiotics to treat the infection; minimize the risk of treatment failure and recurrence, prevent antibiotic resistance [14].

### Key variables

- Socio-demographic characteristics
- Obstetric parameters
- ANC visits during current pregnancy
- Symptoms of UTI in current & previous pregnancies
- Health-related habits during current pregnancy
- Urinalysis, culture & sensitivity findings
- Antimicrobials used for treatment of UTI in current pregnancy
- Maternal & fetal outcomes after delivery

### Treatment and follow up

All the patients, after performing the aforementioned urine tests, were prescribed with the following drugs:

- Tab. Nitrofurantoin SR 100 mg: 1+0+1 for 10 days.
- Tab. Cranberry [Vaccinium macrocarpon] 400 mg: 1+0+1 for 1 month.

After completion of the Nitrofurantoin dose, a repeat Urine R/E test was performed. Finally, after the babies were delivered, the maternal and fetal outcomes were assessed.

### Operational definitions

- **Urinary tract infection (UTI):** A condition in which bacteria invade and grow in the urinary tract (the kidneys, ureters, bladder, and urethra). Most urinary tract infections occur in the bladder or urethra [15].
- **Recurrent abortion:** This is a term used when three or more consecutive abortions have occurred. It is also known as habitual abortion, recurrent miscarriage or recurrent pregnancy loss (RPL) [16].
- **Asymptomatic bacteriuria (ASB):** The presence of bacteria in the urine without any symptoms of a urinary tract infection [17].
- **Mid-stream urine specimen:** a specimen obtained from the middle part of urine flow: clean catch urine specimen [18].
- **Acute pyelonephritis:** Cases with positive urine culture and systemic symptoms (fever, chills, flank pain or back pain) [19].
- **Antenatal Care (ANC) visits:** The World Health Organization (WHO) recommends that pregnant women with normal pregnancies have at least four antenatal care (ANC) visits: 16 weeks, 24–28 weeks, 32 weeks and 36 weeks [3].

### Statistical analysis

All the collected data were coded, entered, and analyzed using the Statistical Package for Social Sciences (SPSS) version 22. Frequency and percentages were used for categorical variables and mean  $\pm$  standard deviation for continuous ones. Data were presented in relevant figures and tables.

### Ethics

Proper safety measures were taken in every step of the study. All the collected information was kept on the personal computer of the principal investigator using password-protected files. The confidentiality and anonymity of the study participants were maintained. According to Helsinki Declaration for Medical Research involving Human Subjects 1964, all the patients were informed about the study design, the underlying hypothesis and the right of the participants to withdraw themselves from the research at any time and for any reason whatsoever.

## RESULT

The study included 140 patients who previously had repeated abortions with symptoms of UTI. After extensive investigation and no significant cause of RPL

being diagnosed, this *valuable* pregnancy was carefully dealt with when the patients reported with UTI symptoms. Relevant investigations were performed and antibiotics were prescribed. Repeat Urine R/E was also done.

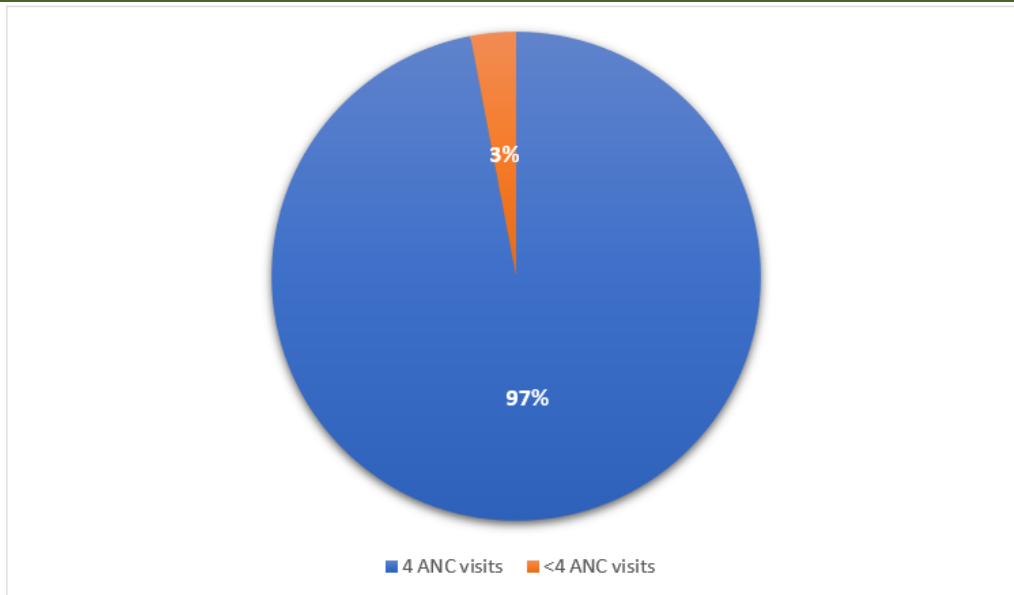
**Table 1: Socio-demographic and obstetric parameters of the participants (n=140)**

Variables	Frequency (n)	Percentage (%)
<b>Age group (in years)</b>		
<25	19	13.6
25-<35	112	80.0
>35	9	6.4
<b>Educational level</b>		
Uneducated	6	4.3
Primary	58	41.4
Secondary	67	47.8
Bachelor's degree	7	5.0
Master's degree	2	1.4
<b>Employment status</b>		
Employed	97	69.3
Unemployed	43	30.7
<b>Socio-economic status</b>		
Low	7	5.0
Medium	128	91.4
High	5	3.6
<b>Area of residence</b>		
Urban	124	88.5
Rural	16	11.4
<b>Trimester of current pregnancy (during 1<sup>st</sup> visit with UTI symptoms)</b>		
First	96	68.5
Second	38	27.1
Third	6	4.28
<b>Number of previous losses of pregnancy</b>		
3	134	95.7
>3	6	4.3
<b>Number of previous live pregnancies</b>		
None	92	65.7
1	35	25.0
≥2	13	9.3

Table above demonstrates the socio-demographic characteristics and obstetric parameters of the respondents. It is clearly evident that, 112 (80.0%) of them were between the age range of 25-<35 years; 67 (47.8%) had completed their secondary education; 97 (69.3%) were employed; 128 (91.4%) belonged to middle socio-economic levels and 124 (88.5%) resided in urban settings. Regarding obstetric history, majority of them, meaning 96 (68.5%) were in the 1<sup>st</sup> trimester of pregnancy when they suffered from UTI symptoms and

visited the OPD of internal medicine department; 134 (95.7%) had 3 previous miscarriages and 92 (65.7) have had no live pregnancies before. [Table 1]

Figure below illustrates a pie chart showing the number of ANC visits the patients performed during their current pregnancy. It can be seen that, majority which is 97% conducted 4 ANC visits. [Figure 1]



**Figure 1: Pie chart demonstrating the number of ANC visits conducted by the participants during their current pregnancy (n=140)**

**Table 2: Predisposing health-related habits of UTI during current pregnancy**

Health-related habits	Frequency (n)	Percentage (%)
Frequent tea consumption	134	95.7
Frequent coffee consumption	98	70.0
Drinking enough water	71	50.7
Regular bladder voiding	68	48.5
Vitamin C intake	49	35.0
Frequent soft drink consumption	30	21.4

**\*Multiple response**

Table above highlights the health-related predisposing factors of UTI during the current pregnancy. It is clearly visible that, most of the participants (95.7% and 70.0%) were involved in frequent tea and coffee consumption respectively during

pregnancy. Besides, good habits like drinking enough water (50.7%) and regular bladder voiding (48.5%) were not very prominently found among the respondents. [Table 2]

**Table 3: Clinical manifestations of UTI during current & previous pregnancies (n=140).**

Variables	Frequency (n)	Percentage (%)
<b>Symptoms (during current pregnancy) (**multiple response)</b>		
Increased frequency of urination	126	90.0
Lower abdominal pain	102	72.8
Flank pain	86	61.4
Painful burning sensation	64	45.7
Strangury	42	30.0
Fever	37	26.4
Dysuria	31	22.1
Incomplete bladder voiding	27	19.3
Change color of urine	6	4.3
Asymptomatic	19	13.8
<b>Symptoms of UTI during previous pregnancies (which resulted in abortions)</b>		
Present	117	83.6
Absent	23	16.4

Table above shows the clinical symptoms experienced by the patients during their current and

previous pregnancies. The commonest symptoms were increased frequency of micturition [126 (90.0%)], lower

abdominal pain [102 (72.8%)] and flank pain [86 (61.4%)]. It can be also seen that, 19 (13.8%) were symptomless during the current pregnancy which means their UTI got detected during routine tests as most of the

patients paid regular ANC visits this time. Regarding previous pregnancies which resulted in abortions, 117 (83.6%) had symptoms of UTI but they did not go for any evaluation. [Table 3]

**Table 4: Laboratory results at baseline and after treatment**

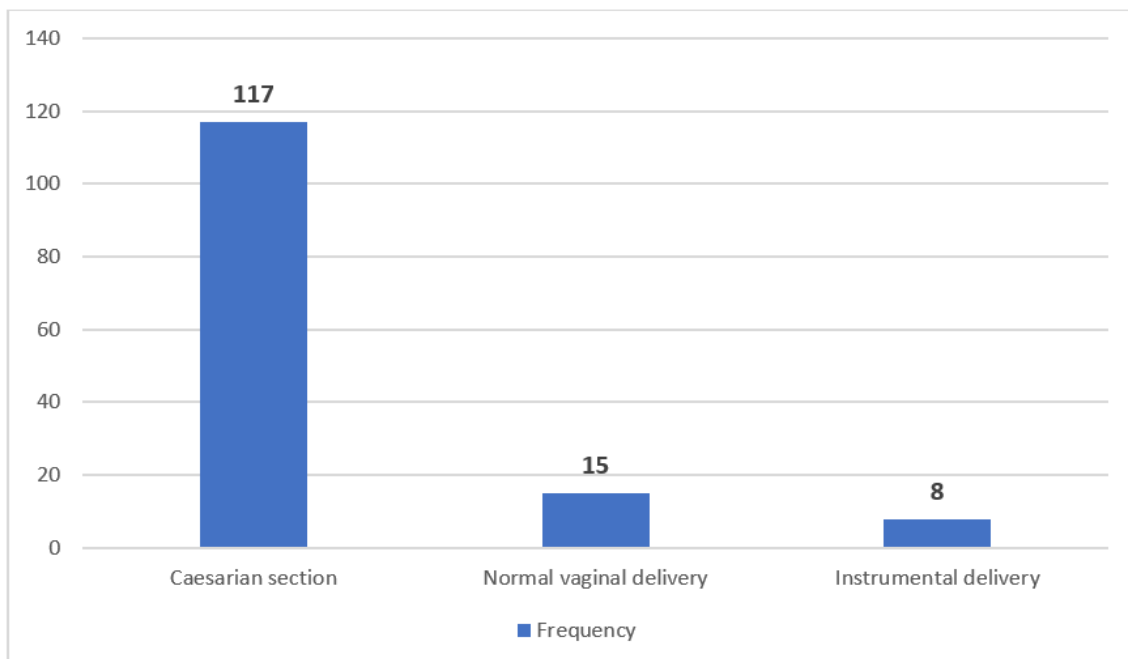
Parameters	Baseline (n/%)	After treatment (n/%)
<b>Urine R/M/E</b>		
<b>Number of pus (WBC) cells</b>		
>5	136 (97.1)	0 (0.0)
0-5	4 (2.9)	140 (100.0)
<b>Number of RBCs</b>		
≥1	6 (4.3)	0 (0.0)
None	134 (95.7)	140 (100.0)
<b>Urine C/S</b>		
<b>Growth positive</b>	62 (44.3)	N/A
<b>Organisms isolated (n=62)</b>		
E. coli	39 (62.9)	N/A
Klebsiella	16 (25.8)	N/A
Proteus	4 (6.5)	N/A
Enterococcus	3 (1.6)	N/A
<b>Nitrofurantoin sensitivity (n=62)</b>	62 (100.0)	N/A

\*WBC: White blood cell; RBC: Red blood cell; N/A: not applicable.

Table above elaborates the urine test findings of the participants before and after treatment with antibiotics. It is visible that, 136 (97.1%) had pyuria before the treatment and after completion of antibiotic course, 100.0% subsidence of pyuria was seen. Hematuria was rare [6 (4.3%)] however, it was fully resolved after treatment. Meanwhile, urine C/S was only done at baseline and it was seen that, 62 (44.3%) patients were reported culture positive; the most frequently

isolated microorganism was E. coli (62.9%). Among the growth positive cases, 100.0% were sensitive to nitrofurantoin, meaning the drug of choice. [Table 4]

Figure below includes a bar chart which depicts the types of deliveries that were conducted for these 140 patients. It can be seen that, maximum deliveries [117 (83.6%)] were done by Caesarian section. [Figure 2]



**Figure 2: Bar chart showing types of deliveries performed (n=140)**

**Table 5: Maternal and fetal outcomes after deliveries of the participants (n=140).**

Outcomes	Frequency (n)	Percentage (%)
<b>Maternal outcomes</b>		
<i>Post-delivery complications</i>		
None	140	100.0
<i>Overall health condition during discharge from the hospital</i>		
Stable	140	100.0
<b>Fetal outcomes</b>		
<i>Live births</i>		
<i>Birth weight <math>\geq 2.5</math> kg</i>	140	100.0
<i>NICU requirement due to low APGAR score at 1<sup>st</sup> and 5<sup>th</sup> minutes</i>	33	23.6
<i>Congenital anomalies</i>		
None	140	100.0
<i>Overall health condition during discharge from the hospital</i>		
Stable	140	100.0

\*NICU: Neonatal Intensive Care Unit; APGAR score: Appearance, Pulse, Grimace, Activity and Respiration.

The table above describes the maternal and fetal outcomes of the study participants who were infected with UTI and got treated. It is visible that, both maternal and fetal outcomes were 100.0% stable with 100.0% live births, all babies' weight at birth was  $\geq 2.5$  kg; no post-delivery complications and no birth defects. It should be mentioned that, 23.6% babies were taken to the NICU for a short instance due to low APGAR scores, however after a while all the babies were stable and healthy at discharge.

## DISCUSSION

Our study found most of the participants age range was 25-35 years; majority had attained their secondary level of education; were mostly employed; predominantly hailed from middle socio-economic background and belonged to urban areas. A recent study [20] conducted in Lebanon depicted that, 62.3% belonged to age range of 25-35 years; 44.19% had completed their Bachelor's degree; 39.07% were employed; 80.93% belonged to medium socio-economic background and 83.26% respondents resided in urban zones. The differences in educational level can be explained by the fact in Bangladesh, most of the girls' education in lower and middle socio-economic levels are emphasized only upto a certain extent; and the variation in employment levels could be due to females in Bangladesh also having to work and contribute in family monthly income.

The investigation found that, maximum participants attended the Department of Internal Medicine with symptoms of UTI at the first trimester of pregnancy; had mostly had previous 3 miscarriages and majority have no previous alive children. Recent paper [21] done in Nigeria demonstrated that 44.85% patients were in their second trimester when diagnosed with UTI. Regional disparities supposedly play a role in the dissimilarities in findings. Besides, relevant paper [22] in Iraq suggests that around 50.0% participants were multiparous.

Our study discovered that majority of the patients were under regular ante natal check ups during the current pregnancy. Study [23] in Bangladesh which was conducted to investigate factors associated with ANC visits among women of reproductive age (15-49) using the Bangladesh Demographic Health Survey 2017-2018 (BDHS) data revealed that, 51.8% of respondents performed incomplete ANC visits during their pregnancies. The difference can be stated by the fact that, education, wealth index, birth order of children and place of residence are some elements which are associated with utilization of ANC visits; however, in our study, this particular pregnancy was highly valuable as a result of multiple abortions previously hence the regularity in ANC visits this time.

Furthermore, consumption of tea and coffee were common findings among the respondents; whereas drinking sufficient water and frequent bladder voiding were not so pronounced. The findings from a recent study [20] in Lebanon were dissimilar; only frequent bladder voiding was not found commonly in pregnant women which was a major predisposing factor for occurrence of UTI. Bangladeshi women particularly are not concerned much about their health and in this case, most of the participants were employed, as a result they must have been indulging regularly in tea and coffee. In addition, due to lack of time they must have delayed bladder voiding frequently.

Our findings suggested the commonest clinical manifestations to be increased frequency of micturition, lower abdominal pain as well as flank pain. A study [20] referred to increased frequency of urination, dysuria, change of urine color, incomplete bladder voiding and lower abdominal pain to be most frequently occurring symptoms in the pregnant women with UTI.

The study revealed that, pyuria was almost present in all cases before initiation of treatment; hematuria was rare. After completion of antibiotic treatment, the problems subsided completely.

Meanwhile, an abundant proportion had culture positive specimens, in which the commonest organism isolated was *E. coli* followed by *Klebsiella*. Among the culture positive cases, all of them were sensitive to nitrofurantoin. A similar study [4] done in India reported that, 56% cases had pus cells 6-10 in number in Urine R/M/E examination; the commonest causative organisms were *E. coli* (38%); *Klebsiella* (24%) and *Proteus* (17%). Also, most common susceptible antibiotic was found to be nitrofurantoin (83%). However, the selection of treatment regimen depends on multiple factors, ranging from antibiotic susceptibility, pregnancy category and safety profile, regional variations and physicians' preferences.

Investigation revealed that, delivery was mostly done by Caesarean section. Recent study [24] done in Bangladesh suggested that, 85% deliveries were performed by CS. C-section was the most opted delivery method as these pregnancies were precious so both the physicians and patients relied on this.

Lastly, it was seen that, both maternal and fetal outcomes were stable. All the babies were alive and healthy at discharge. However, recent studies [4, 25] in India and Bangladesh revealed the commonest maternal outcomes of UTI were anemia (26%; 25.4%) and puerperal pyrexia (23%; 23.2%) and fetal outcomes were preterm birth (35%; 34.9%). Our participants did not develop any significant abnormalities as they completed the treatment with Nitrofurantoin and Cranberry successfully and were under regular ANC during the current pregnancy.

### Limitations

- Personal hygiene and sanitation parameters such as hand-washing, toilet settings and facilities, cleaning of genital area from front to back after urination not assessed.
- Maternal nutrition and weight status not taken into consideration.
- Frequency of sexual activity not evaluated.

### CONCLUSION

Prompt treatment with antibiotics can significantly cure urinary tract infections in pregnancy and prevent complications for both mothers and babies. Regular ante natal check up during pregnancy is inevitable in detecting all abnormalities and ensuring safe delivery. Screening and diagnosing diseases are of core importance.

### Recommendations

- It can be advised to drink cranberry juice regularly those who are prone to UTI as cranberries can prevent *E. coli* from adhering to the bladder.
- Long journeys during pregnancy should be highly discouraged.

- Proper hydration should be maintained.
- Caffeine intake should be avoided.

**Conflict of interest disclosure:** The authors declare that they have no conflicts of interest.

**Sources of funding:** None.

### REFERENCES

1. Kerure, R. D., Biradar, A. V., Lakshetty, S., & Biradar, S. (2024). A study of urinary tract infection in pregnancy and its effect on maternal and perinatal outcome. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*, 13(2), 284-290.
2. Mahor, S., Malviya, R., & Goyal, R. (2021). Study of incidence of urinary tract infection during pregnancy and its effect on maternal and perinatal outcome. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*, 10(4), 1497-1503.
3. Ranjan, A., Sridhar, S. T. K., Matta, N., Chokkakula, S., & Ansari, R. K. (2017). Prevalence of UTI among pregnant women and its complications in newborns. *Indian Journal of Pharmacy Practice*, 10(1).
4. Kumar, G., Choudhary, T. S., Srivastava, A., Upadhyay, R. P., Taneja, S., Bahl, R., ... & Mazumder, S. (2019). Utilisation, equity and determinants of full antenatal care in India: analysis from the National Family Health Survey 4. *BMC pregnancy and childbirth*, 19, 1-9.
5. Gomindes, A. R., Bhakthavalsalan, R., Sharma, U., Johnston, S. L., & Naushad, A. (2022). Prevalence of High-Risk Pregnancy Among Pregnant Women Attending Antenatal Care Camps in Primary Health Centres in Kinaye and Vantamuri and Their Sub-Centres. *Cureus*, 14(7).
6. UNICEF. Antenatal care - UNICEF DATA [Internet]. UNICEF DATA. 2024. Available from: <https://data.unicef.org/topic/maternal-health/antenatal-care/>
7. Mu, F., He, T., Wang, K., & Wang, F. (2024). Knowledge, attitudes, and practices of patients with recurrent pregnancy loss toward pregnancy loss. *Frontiers in Public Health*, 11, 1308842.
8. McDermott, S., Daguise, V., Mann, H., SZWEKBKA, L., & Callaghan, W. (2001). Perinatal risk for mortality and mental retardation associated with maternal urinary-tract infections. *Journal of family practice*, 50(5), 433-433.
9. Ansaldi, Y. & de, Tejada, Weber, B.M. (2023). Urinary tract infections in pregnancy. *Clinical microbiology and infection*. 1;29(10), 1249-53.
10. Schneeberger, C., Geerlings, S. E., Middleton, P., & Crowther, C. A. (2012). Interventions for preventing recurrent urinary tract infection during pregnancy. *Cochrane Database of Systematic Reviews*, (11).



11. Corrales, M., Corrales-Acosta, E., & Corrales-Riveros, J. G. (2022). Which antibiotic for urinary tract infections in pregnancy? A literature review of international guidelines. *Journal of clinical medicine*, *11*(23), 7226.
12. Ailes, E. C., Gilboa, S. M., Gill, S. K., Broussard, C. S., Crider, K. S., Berry, R. J., ... & National Birth Defects Prevention Study. (2016). Association between antibiotic use among pregnant women with urinary tract infections in the first trimester and birth defects, National Birth Defects Prevention Study 1997 to 2011. *Birth Defects Research Part A: Clinical and Molecular Teratology*, *106*(11), 940-949.
13. Zhang, Z., Liu, J., Cheng, Y., Chen, J., Zhao, H., & Ren, X. (2022). Urine analysis has a very broad prospect in the future. *Frontiers in Analytical Science*, *1*, 812301.
14. Alkhalwaldeh, R., Abu Farha, R., Abu Hammour, K., & Alefishat, E. (2022). Optimizing antimicrobial therapy in urinary tract infections: a focus on urine culture and sensitivity testing. *Frontiers in Pharmacology*, *13*, 1058669.
15. National Cancer Institute. <https://www.cancer.gov/publications/dictionaries/cancer-terms/def/urinary-tract-infection> [Internet]. www.cancer.gov. 2011. Available from: <https://www.cancer.gov/publications/dictionaries/cancer-terms/def/urinary-tract-infection>
16. Ford, H. B., & Schust, D. J. (2009). Recurrent pregnancy loss: etiology, diagnosis, and therapy. *Reviews in obstetrics and gynecology*, *2*(2), 76.
17. Givler, D.N. & Givler, A. (2020). Asymptomatic Bacteriuria [Internet]. PubMed. Treasure Island (FL): StatPearls Publishing. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK441848/>
18. Emiru, T., Beyene, G., Tsegaye, W., & Melaku, S. (2013). Associated risk factors of urinary tract infection among pregnant women at Felege Hiwot Referral Hospital, Bahir Dar, North West Ethiopia. *BMC research notes*, *6*, 1-6.
19. American College of Obstetricians and Gynecologists. ACOG Practice Bulletin No. 91: Treatment of urinary tract infections in nonpregnant women. *Obstetrics and gynecology*. 2008 Mar;*111*(3):785-94.
20. El-Kashif, M. M. L. (2019). Urinary tract infection among pregnant women and its associated risk factors: A cross-sectional study. *Biomedical and Pharmacology Journal*, *12*(4), 2003-2010.
21. Ezugwu, I. A., Afunwa, R. A., Onyia, F. C., Chukwunwejim, C. R., Offe, I. M., Onyia, C. O., ... & Eze, E. A. (2021). Prevalence of urinary tract infections and associated risk factors among pregnant women in Enugu Metropolis, Nigeria. *Journal of Biosciences and Medicines*, *9*(10), 156-171.
22. Taha, A. B. (2024). Bacteriological profile, antimicrobial susceptibility, and factors associated with urinary tract infection in pregnant women. *The Journal of Infection in Developing Countries*, *18*(03), 391-398.
23. Akter, M. B., Mahmud, A., & Karim, M. R. (2023). Determinants of Antenatal Care Visits in Bangladesh: A Quantile Regression Analysis. *Health Services Research and Managerial Epidemiology*, *10*, 23333928231168119.
24. Biswas, R. K., Jahan, M. R. T. K. N., Hasnat, N. B. S. K. F., Jahan, N., Sazal, R. M. H., Rahman, A. K. M. P. M., ... & Rahim, M. A. M. (1819). C Editorial. *Cell*, *88*(80), 30-50.
25. Khatun, D.K., Laila, Islam, D.S., Salma, D., Dr Romena, Afroze. & Dr. Walida, Afrin. (2024). Urinary tract infection in pregnancy and its effect on maternal and perinatal outcome. *International Journal of Clinical Obstetrics and Gynaecology* [Internet]. *8*(5),163–7. Available from: <https://www.gynaecologyjournal.com/archives/2024/vol8issue5/C/8-5-18>